

REMARKS

Claims 1-10 are all the claims pending in the application.

Clarifying Amendments to the Claims

To improve the clarity and consistency of the claim language, Applicants have revised several of the current claims. Specifically, “said first step” has been replaced by “the processing step” in claim 1, and the article “the” has been added before “laser beam” in claims 3, 4, 7, and 9. In addition, the limitation “said insulating layer is made of polyimide resin” has been moved to the end of claim 3, in order to clarify that this limitation is not present in independent claim 1. Other improvements in grammar have been made in several claims, with no intended change in meaning or scope.

Claim Rejections Under 35 U.S.C. § 112, Second Paragraph

Claim 9 has been rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicants regard as the invention. The Examiner maintains that it is unclear what “a pulse beam on time of 10s” refers to. A typographical error has been corrected in the length of the pulse beam on time, such that “10s” now correctly reads as “10μs” in claim 9. To clarify the intended meaning of the claims, “pulse beam on time” has been replaced with “pulse beam irradiation time” in claims 7 and 9.

Claims 8 and 10 have been rejected under § 112, second paragraph, as allegedly being incomplete for omitting essential steps. The Examiner argues that because these claims do not mention the use of two laser beams, it is impossible to perform the processing step and the hardening step simultaneously. To address the Examiner’s rejection, the claims have been clarified to specify that the laser irradiation for the processing step is from a first laser beam, and the laser irradiation for the hardening step is from a second laser beam.

Claim Rejections Under 35 U.S.C. § 102(b) - Owen

Claims 1, 4, and 5 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 5,841,099 to Owen et al. (hereinafter “Owen”). Applicants traverse the Examiner’s rejection of these claims.

Independent Claim 1

The Examiner maintains that Owen teaches all of the elements of claim 1. Owen discloses a method for using ultraviolet laser pulses to form vias in multilayer targets with metallic layers and a dielectric layer (abstract). Owen uses a first pulsed laser beam with a power density above the metal ablation threshold to machine through a metallic layer (col. 3, lines 18-20). Owen then uses a second pulsed laser beam with a lower power density and equal spot size to machine through a dielectric layer (col. 3, lines 20-22 and 37-40). Alternatively the spot size of the second laser beam can be greater than the spot size of the first laser beam, while the power density of the second laser beam is equal to or lower than the power of the first laser beam (col. 8, lines 51-54 and 64-66).

Owen does not anticipate the claimed invention. Owen does not teach or suggest “hardening said insulating layer by applying a laser beam at a lower energy density than said predetermined energy density of the processing step around a processed portion processed in the processing step,” as required by claim 1 (emphasis added). In contrast, Owen only irradiates the dielectric layer with a single laser beam (the second laser beam) for material removal purposes, and does not harden a processed portion of the dielectric layer by applying another laser beam with a lower energy density than the second laser beam, as required by claim 1. Owen simply uses the first laser beam to ablate the metallic layer, and then uses the second laser beam with a lower power density to remove the dielectric layer. The second laser beam removes the entire dielectric layer (col. 8, lines 19-22). There is no teaching or suggestion of hardening the dielectric layer in Owen. At least by virtue of the aforementioned differences, Applicants’ claim 1 distinguishes over Owen. Claims 4 and 5 are dependent claims including all of the elements of

independent claim 1. Therefore, at least because of their dependencies, claims 4 and 5 are patentable over Owen.

With further regard to dependent claim 5, Owen teaches away from using “a carbon dioxide gas laser having a wavelength of 10.6μm” for the laser material processing. Owen states that such lasers generate spot sizes that are too large for via processing (col. 2, lines 44-47). Also, carbon dioxide lasers have longer pulse widths than ultraviolet lasers, and use a thermal process instead of a photochemical process (col. 2, lines 47-51). Therefore, Owen uses ultraviolet lasers in removing both metallic and dielectric layers (col. 9, lines 20-21). In light of this distinction, as well as claim 5’s dependency on independent claim 1, dependent claim 5 is patentable over Owen.

Claim Rejections Under 35 U.S.C. § 103(a) – Owen in view of Hino

Claims 2, 3, and 6 have been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Owen in view of U.S. Patent No. 6,037,103 to Hino. Applicants traverse the Examiner’s rejection of this claim. As discussed above, Owen does not teach or suggest a hardening step, which is an element of dependent claims 2 and 3. Hino does not remedy this deficiency in Owen. Hino is generally directed toward forming holes in printed resin boards (col. 1, lines 7-11). Hino uses beam shaping techniques to make a laser beam pass simultaneously through a mask’s light path holes, which correspond to the holes to be formed in the resin board (col. 4, lines 13-19). Hino also uses this laser ablation technique to simultaneously remove the residue attached to the inside or the vicinity of each hole (col. 6, lines 47-60). Like Owen, Hino only uses a laser beam to ablate the resin, not to harden the resin, as required by claims 2 and 3. Therefore, claims 2 and 3 are not rendered obvious by Owen in view of Hino.

Independent Claim 6

For the same reasons, independent claim 6 is not rendered obvious by Owen in view of Hino. Claim 6 recites “hardening said insulating layer by applying a laser beam at an energy

density of $0.5\text{J}/\text{cm}^2$ or less around a processed portion processed in the processing step” (emphasis added). Because neither Owen nor Hino teach or suggest hardening an adjacent insulating layer, independent claim 6 is patentable over Owen in view of Hino.

Claim Rejection Under 35 U.S.C. § 103(a) – Owen and Hino further in view of Kurosawa

Claim 7 has been rejected under § 103(a) as allegedly being unpatentable over Owen and Hino and further in view of U.S. Patent No. 6,373,026 to Kurosawa et al. (hereinafter “Kurosawa”). Applicants traverse the Examiner’s rejection of this claim. As discussed above, neither Owen nor Hino disclose a hardening step, as required by claim 7. Kurosawa does not remedy this deficiency in the other cited references.

Kurosawa discloses a laser beam machining method for a wiring board, including irradiation of a machined portion of the wiring board with a pulsed laser beam for 10 to 200 μs (col. 4, lines 43-49). In one embodiment Kurosawa ablates a metallic layer and the insulating base material, and then additionally irradiates the removed base material portion and/or the periphery of the removed base material portion (col. 27, lines 28-40). This allows the deposits generated during the machining to be removed without wet etching (col. 27, lines 40-44). However, Kurosawa does not disclose that the additional irradiation hardens the base material. Therefore, at least because of these differences, and because of its dependency on independent claim 1, dependent claim 7 is patentable over Owen and Hino in view of Kurosawa.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Amendment Under 37 C.F.R. § 1.111
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The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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